USAID FIRMS PROJECT

FISH FARMING STRATEGY

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Abstract

This report introduces the current situation in the fish farming sector in Pakistan with particular emphasis on issues observed in the field in the Sukkur and Larkana districts. Findings in the report are derived from extensive interactions with sector principals, scientists, government officials, representatives of large supermarkets, financial institutions and poultry feed manufacturers and reading reference materials.

The report recommends a strategy and action plan that will address global and specific issues currently preventing economic growth. This 3-year strategy centers on simultaneously boosting productivity and marketing aspects, while operating a major shift of capital currently blocked in production back into the sector and the supply chain to ensure economic growth. While focusing on achieving results at the local level in two districts, it also aims to make strategic use of USAID investment to create an enabling business environment that will give, for the first time, an industrial outlook to the sector.

Acronyms

KPK	Khyber Pakhton Khuwah
ADB	Asian Development Bank
FDB	Fishery Development Board
AJK	Azad Jammu and Kashmir
BFRI	Bangladesh Fisheries Research Institute

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Executive Summary

Fish farming in Pakistan is a sector where donor assistance can truly be felt by the people engaged in the sector and by consumers if issues are addressed in their complexity. Especially in Pakistan, significant market opportunities exist to provide the growing population with animal protein. However, to this day, Pakistani people are one of the smallest fish consumers in the world due to both consumer habits and lack of access to quality products.

Seizing opportunities will require working progressively and in a demonstrative manner in Sukkur and Larkana, the two “at-risk” target districts located in Sindh to overcome constraints in seed production, fish farming practices, fish handling, marketing, and building stakeholder motivation and consumer confidence. Recommended interventions are guided by a holistic entrepreneurial approach that ensures the gradual autonomy of beneficiaries and successful partnerships. While focusing on achieving results in the two districts, it also aims to make strategic use of USAID’s investment to create an enabling business environment that will give for the first time an industrial outlook to the sector.

The 3-year strategy centers on boosting productivity and marketing aspects while simultaneously operating a major shift of capital currently blocked in production back into the sector and the supply chain to ensure economic growth.

Interventions will improve fish quality and develop a traceability and eco-label product, increase fish growth and double productions, help build Pakistani competitiveness in the regional market, increase fish consumption in Pakistan, and secure a healthy, structured professional and business environment. Outputs will provide farmers with a better income and forward-looking working conditions and influence. Value-added on fish product will create new employment opportunities involving women while profits made from the sale of quality products will contribute to further expanding sector growth and secure its sustainability.

Recommended interventions focus on:

- Building a win-win entrepreneurial farmers/commission agents-buyers alliance to establish an organizational framework and facilitate access to market opportunities;
- Involving a financial institution as a partner to the farmers/commission agents-buyers alliance to accompany progressive farmers’ autonomy and help commission agents/buyers invest in equipment while recovering their capital currently on loan to farmers;
- Securing a constructive and intelligent market linkage with a strategic large supermarket that will help u
  p-grade value chain performance and develop a local label product to ensure price stability in spite of growing production;

- A model hatchery to provide the basis for starting a full cycle culture practice for future export quality fish production, to certify origin of the seeds and to improve stocks with technical assistance from Bangladesh, a regional leader in carp production and genetic stock improvement;
- Making proper, balanced and cost-effective fish feed available to farmers for carp and pangasius species;
- Capacity-building, training and awareness benchmark tours provided to farmers and commission agents-buyers;
- Setting up a company registered under Section 42 owned by farmers/commission agents-buyers/financial institution alliance with an objective to develop self-sustained business activity through sale of seeds and fish feed in order to ensure post-project regular free technical assistance to farmers and the continuation of work conducted at the hatchery to improve quality seeds.
- Major accomplishments of this assignment were not only to identify gaps and to recommend solutions, but it also mobilized all stakeholders in the sector and received their enthusiasm and willingness to engage in an implementation phase of the project. Partners and potential investors, financial institutions, large supermarkets, large farm owners, international technical assistance and poultry feed manufacturers were all identified.

In the current sector situation, short-term interventions will not produce a true impact. However, investing in a 3-year strategy would provide sufficient time to overcome obstacles and to build relationships to succeed and achieve project objectives.
The development of fish farming could considerably change Pakistan's landscape and improve its population's livelihood and diet, thus providing well-grounded and lasting visibility for USAID.

1. BACKGROUND

The objective of the USAID Pakistan Firms Project is to promote economic growth in "at risk" districts to undercut the basis of extremism through activities that increase investment, improve products and services, expand sales and exports, increase jobs and income, and engage women. Project activities and interventions are focused on specific economic sectors, one of which is inland fisheries- more specifically, fish farming.

Priority was given to two "at-risk" districts i.e. Sukkur and Larkana located in northern Sindh, east and west of the Indus River, to develop a 3-year sector strategy. Sukkur is an important hub of business activity in Sindh and hosts one of the largest fish market in the country. Strategically located near the provincial boundaries of Baluchistan and Punjab and on a main axe for passengers and goods transport facilities, it is able to sell and supply agricultural produce (crops, fruits and vegetables), livestock and animal husbandry, forestry and fisheries products to all main cities in the country. According to the 1998 Census the total population of Sukkur District was 908,037 with average annual growth rate of 2.88%.

Larkana District is known as the Garden of Sindh. Established in a fertile plain, its economy is largely dominated by agriculture activities. The District has a long political history and is the home of several country leaders. Larkana is also famous for one of the world's oldest archaeological sites, 'Moenjo-daro' or the mound of the Dead, designated a UNESCO World Heritage Site. According to the 1998 Census, the population was 1,006,998 inhabitants with the growth rate of 3.14%. More than 70% of the total population of the district lives in the rural areas.

Due to their distance from Karachi and insecurity, both districts have received little support and attention from government projects. However, they offer great potential to impact on a large number of livelihoods and to create an enabling business environment that will help improve fish farming practices across the country in the future.

Based on data collected in the field and meetings and interviews with sector stakeholders, this document proposes a 3-year strategy to empower local communities from Sukkur and Larkana districts to drive their own development and progress through critical mass eco-friendly export quality traceability fish farming products activity.

2. INTRODUCTION TO FISH FARMING IN PAKISTAN

BRIEF HISTORY AND CURRENT SITUATION

Aquaculture is a recent development in Pakistan. Fish farmers stock ponds with Indian carp species such as Catla, Rohu and Common carp and two Chinese carp species, Grass carp and Silver carp. Two species of trout, namely brown trout and rainbow trout are cultured in Khyber Pakhton Khuwah (KPK) and Azad Jammu and Kashmir (AJK) located in northern Pakistan.

In major parts of the country, fish farming is mainly practiced at an extensive level characterized by low per unit yield due to poor management, lack of access to quality seeds and unavailability of proper fish feed. Carp farming was first introduced as another “agriculture” activity to make use of land not suitable for agriculture and to provide people with an income. Ponds were filled with water and incoming seeds as well as additional available artificially bred seeds. Little input was and is still used except for manure. Fish are harvested after one to two years depending on the size or the owner’s need for cash. The sector gained pace in the mid-eighties with two Asian Development Bank (ADB) projects which assisted in strengthening the institutional structure, with the development of hatcheries and juvenile production, model farms, transfer of technology and human resource development. The sector also received a substantial amount of government investment over the past decades for the development of aquaculture and training facilities. In spite of these efforts and of pro-active large farm owners’ initiatives, fish farming has not reached an industrial outlook. The main reasons are lack of access to quality seeds as a result of genetic degradation largely influenced by practices at hatchery level, lack of fish species options, unavailability of proper fish feed and lack of backup health services. Farm owners’ perceptions and lack of motivation to further invest is also an important factor. In some cases, fish farming is considered as a side activity that doesn’t require much investment; while in other cases, lack of awareness and high financial cost doesn’t enable farmers to foresee fish farming as a profitable opportunity. Demonstration and persuasion are required to operate a change in mentalities and practices as it will in turn condition the development of an allied industry. An example is the fish feed mills, which so far have not represented a profitable market for investors due to little use of input.

With both marine and fresh water capture fisheries almost exceeding maximum sustainable yields, the fishery national policy of Pakistan focuses on issues relating to sustainability, better exploitation strategies, reduction in post-harvest losses, value addition and conflict resolution. Fish farming is seen as a way to enhance fish supply for food security. However, implementing a viable aquaculture industry to feed its population and to stimulate economic activity remains a challenge.

3. METHODOLOGY

Meetings and interviews were conducted in Karachi, Islamabad, Lahore and Sukkur with large farm owners in Thatta/Chyllia and Jacobabad, large fish buyers in Lahore, national experts and scientists, university professors, leaders and members of associations and organizations, representatives of financial institutions, large supermarketS, poultry feed manufacturers and government officials to get an overview of the sector, its challenges and related market issues.

A consultative meeting and a consultative workshop comprising respectively sixty farmers from Larkana and twenty commission agents and fish buyers from Sukkur were organized to allow for spontaneous in-depth working sessions.

Visits to farms, private and public hatcheries and fish auction markets in Sukkur and Larkana gave an opportunity to get a clearer picture of the ground realities and of current working conditions.

In an attempt to analyze the value chain and to understand the issues stakeholders are facing and blockages preventing economic growth in Sukkur and Larkana districts, data was collected from a sample of farmers, hatchery owners, commission agents and fish buyers to 1) learn about current fish farming business models and estimate current profit margin, 2) evaluate the profitability of small private-owned hatcheries at farm level, and 3) evaluate the situation with respect to capital flow in the sector.

For comparative purpose, data and information were also collected from [redacted] who helped facilitate and organize market linkage and collaboration between farmers from Muzzafargah and the large supermarket Metro.

4. FINDINGS

Findings presented below resulted from visits of farms, hatcheries and fish markets and analysis of all data and information collected from nearly 130 stakeholders as referred to above.

4.1 Value Chain Analysis

Problems have been identified all along the value chain starting with the lack of access to quality seeds to non-existing market health and sanitary standards, and inadequate working facilities for handling fish and supplying quality products as illustrated in Figure 1.

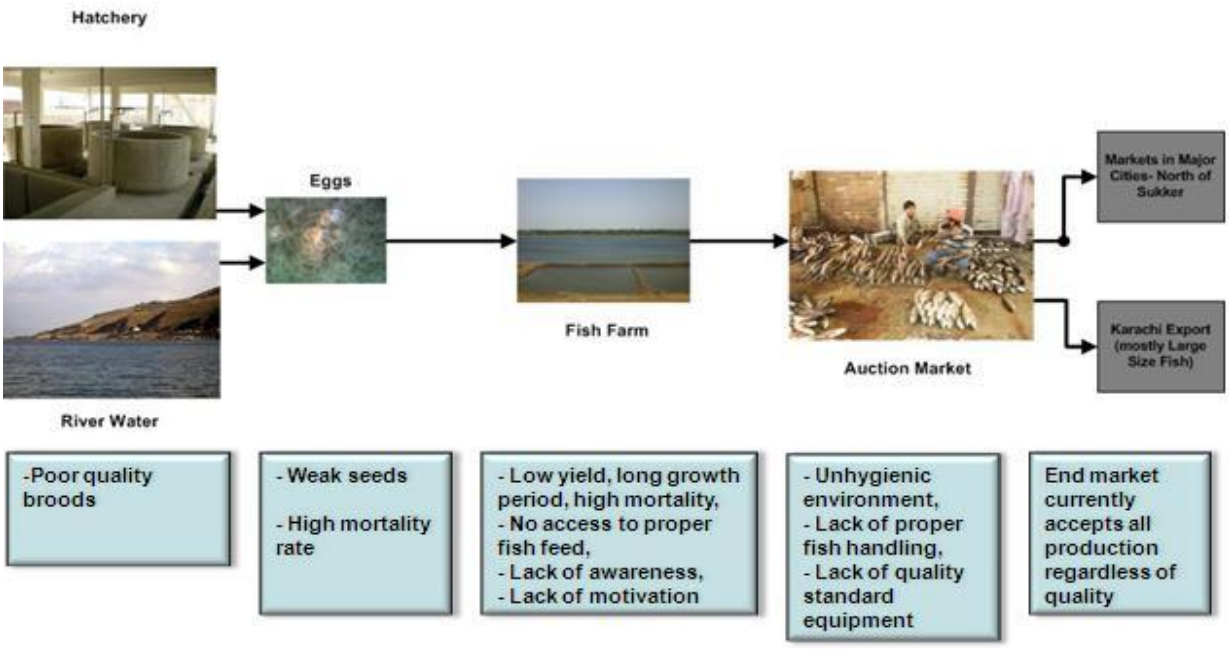

Figure 1: Value Chain: Current Situation

a) Access to quality seeds

The difficulty in accessing good quality seeds results from common practices observed at the hatchery level. Hatcheries maintain minimal brood stock populations, recruit successive generations of brood stock from within the 'system' and spawn multiple species simultaneously in common tanks to minimize production costs. Broods are

usually of small size for their age. The available evidence supports a regional perception that genetic degradation of hatchery stocks is occurring, and that both inbreeding depression and inadvertent hybridization are common problems contributing to poor quality seed production.

Poor quality seeds impact the production both in terms of the mortality rate and growth. All principals interviewed, small and large farm owners, have raised the issue of lack of access to quality seeds. In Sukkur and Larkana, some buy seeds in local hatcheries as well as in Punjab while other farmers with large areas of land have set-up their own small private hatchery with nurseries to produce their seeds.

Neither solutions have produced substantial changes: 1) the mortality risk increases due to transport conditions and 2) seeds remain weak since they are produced from initial poor quality broods.

Seeds are sold either per liter or per 100 ml for hatchling size or per unit starting from 1-2 inch fingerlings. A liter of hatchling may contain hundreds of thousands of egg but the mortality rate is extremely high, ranging from 80 to 100%. The bigger the fingerlings, the more expensive they are but have a lesser mortality rate and less rearing time at a nursery pond are required. It takes 6-8 months to rear hatchling and grow 1-2 inch size fingerlings to 7-8 inches, a good size for stocking grow out ponds.

Lack of access to quality seeds is a serious issue and a factor that discourages principals, uneducated farms owners or small farms owners, to invest in the sector and tends to motivate them to pursue extensive fish farming practices.

All large farms owners are searching for ways out of the problem. Some plan to set-up their own hatchery while others work in close collaboration with serious existing hatcheries and grow their own broods. All are trying to find a solution to improve the situation and contemplate a quick way out option of importing seeds from Bangladesh already known to them as a regional leader in carp farming. But uncontrolled import could lead to another serious problem i.e. spread of disease.

Hatcheries' practices and the resulting situation are not particular to Pakistan. All carp farming countries in Asia, i.e. northern India, Nepal, Bangladesh and Myanmar are confronted with this issue and are working at improving carp genetics.

Bangladesh has been conducting genetic stock improvement research of tilapia and carp species since 1994. It is one of the extremely successful countries in the region in developing three genetically improved strains, which have been successfully dissimilated in the field to promote freshwater aquaculture.

The issue regarding the absence of brood stock management in Pakistan has often been raised, thus threatening the development of the sector unless proper investment in seed genetic improvement is done.

b) Fish farming practices

Fish farming is characterized by polyculture of different species of carps. It is done on a limited scale using extensive farming practices with very little input, either as a livelihood or as an extra income, for land not suitable for agriculture.
There is no recent data available on the total number of farms and size of farms located in Sukkur and Larkana. Based on information collected locally, the total number of farms could range from 300 to 400. The size of ponds and farms vary from 1 to 100 acres with an average size of 2 to 5 acres per farmer. Lack of awareness about pond management throughout production cycle and fish feed together with the non-availability in Pakistan of proper balanced and cost-effective fish feed all explain the current state of art. Few farmers know how to prepare ponds. Buffalo dung is used as a fertilizer but in most cases, the large number of buffalos in the ponds results in over fertilization. Furthermore, water control to ensure proper level of fertilizer and oxygen is done intuitively. All these factors tend to increase fish mortality rate.

Current fish feed practices tend to further complicate the farmers' assessment of meeting fish needs. Farmers mix wheat bran, rice polish and mustard oil and spread it around the ponds. Carp is a slow eater and the feedstuff has to be water stable. With the current system, the fish do not intake their nutrition needs at once and a large portion of the feed ends up being wasted, thus increasing the level of fertilizer further. In Sukkur and Larkana, half of the farmers interviewed choose to buy only hatchling while others buy fingerlings of 1-2 to 4-5 inches. Hatchling and fingerlings are then grown in nursery ponds prior to stocking in grow out ponds. The length of time in the nursery varies from 3 to 8 months depending on the initial size of seeds. Those who buy hatchling may want to grow enough fingerlings of various sizes either to stock their ponds or to sell fingerlings to other farmers, or both. In any case, the choice of options remains a gamble but chances are greater when stocking ponds with bigger fingerlings.

Observations from the field also showed that farmers tended not to wait until all the production had reached commercial size to harvest at once and start a new crop. They keep adding new juveniles into the ponds throughout the year. The cycle of production is therefore over two years and production averages 700 kg/acre for that whole period of time or an average of 500 kg/acre per year (confirming FAO figures). It operates as a livelihood "basket" for them. This way, every time they need cash, they can sell the bigger fish. This has complicated the breakdown of operation cost and the evaluation of estimated profits made from this activity. Financial analysis show that profits made are very low and average Rs. 33 000 per acre but are not felt as such because 1) receipts come in now and then from occasional sales of fish and 2) farmers do not manage their activity as a business. When asked about market issues, farmers said that they generally don't have any major problem and that all production sells.

c) Sales and markets

Once fish are harvested, they are piled up on the back of a pick-up to be sold at the nearest market, either in Larkana or in Sukkur. Sukkur is the largest market in the region gathering both inland capture fish and farmed productions from all surrounding districts as far as Jacobabad. Upon arrival at the auction market, fish are loaded on the ground and sorted by size and species. Conditions are extremely unhygienic with limited use of ice and clean water. Access to ice is difficult due to regular power supply cuts and high cost of running generators. Ice can get very expensive during the summer. There are no proper tiled and equipped working rooms. Fish buyers are very poorly equipped and have expressed concern over the lack of cold chain and storage facilities and pointed out transport as major issues. Market areas in Sukkur are very congested. The Fishery Development Board plans to build cold storage and working facilities within the next 2 years.

The sale of fish to local fish buyers goes through a commission agent in charge of facilitating the auction and making immediate payment to the farmer[1]. The commission agent takes a commission of 6% on the total value of the fish sold. If the farmer has contracted a loan to cover production cost, the commission agent will take an 8% commission and deduct the initial amount that he has lent to that farmer.

From the Sukkur market, fish are than sold to main cities such as Peshawar, Lahore and Islamabad, and in local markets. Smaller size fish are sold to Afghanistan while larger size and “best” quality fish are sold to Karachi. According to fish traders, there is a growing demand for fish from Afghanistan. A market study would need to be done to investigate on this potential market. Due to the lack of proper infrastructure and facilities, fish traders face 20% price reduction of the value of the fish they in turn sell to other buyers and markets. Only 5% of the volume landed is rejected showing a very uncritical end market. However, this is a cost that local fish traders bear and depending on the volumes, it can amount to a non-negligible sum.

A consultative workshop with twenty commission agents and fish traders from Sukkur showed their poor understanding of quality issues, basic requirements and export quality regulations. They understand the need to improve working conditions and the necessity to supply quality fish. Large imports of carp and pangasius filets from Burma and Vietnam have increased over the past 8 years. Except for pangasius, consumers still prefer local fresh carp. An interview with a fish trader and importer in Lahore indicates that imports of carp have slowed down over the past 3 years due to increased productions of carp from large farms located in Punjab and Sindh.

[1] Farmers have mentioned that payment are often delayed

4.2 Analysis of the financial set-up of the sector

Analysis of the capital flow in the sector shows that capital is blocked in the production phase, thus preventing investment in the sector and supply chain, and therefore any economic growth.

Commission agents usually lend money to farmers in exchange of the auction sale of their production, which according to the general understanding between the two parties shall be equivalent to five times the value of the initial sum of money lent and a commission of 8% on the total value of the fish sold. For example, commission agents lend approximately Rs 20 000 per acre per farmer. One or two years later, if the farmer (as per the understanding between the two parties) sells the equivalent of approximately Rs 100 000 to a local fish trader via the commission agent, the commission agent will first deduct Rs 20 000 he initially lent him and then will deduct Rs 8000 (8% of Rs 100 000), leaving the farmer with Rs 72 000. The total financial cost for the farmer amounts to 40% of the money he has borrowed.

Looking at the situation from the commission agent's point of view, the interest rate is high because he bears all the risks. Firstly, the farmer has to produce and to sell the fish through him. If the farmer has not been able to produce, then he loses his investment. Secondly, he advances the payment of the fish to the fish trader since that person doesn't have any capital and makes profit on the re-sale of the products to other fish buyers in other cities. If the fish trader has problems selling the fish or getting paid in time, it reduces automatically the commission agent's cash flow and profit margin. In the current system, only the commission agents make a profit.

From the farmer's perspective, the financial cost is high and the amount borrowed does not enable him to cover all operational cost. Analysis of current business model shows that operational costs per acre amounts to Rs 75 000. The Rs 20 000 borrowed from the commission agent only covers part of the cost, leaving the farmer either to find alternative sources of funding or to find solutions to reduce the costs, i.e. prepare the land only once every 2 to 3 years, cut down on the feed cost or gamble with various seed options. But, the fact that he sees a considerable sum of money when he sells the fish tends to make him believe that fish farming is a good business. He doesn't realizes that once he has paid off the loans and calculated all his input throughout the year, e.g. for feed, profits are quite meager.

Difficulties accessing bank loans have been raised by farmers during consultative meeting. They said that no bank was willing to work with farmers. When asked, financial institutions said that 1) Sukkur and Larkana are considered at "risk districts" and 2) that fish farmers do not have the reputation to pay back their loans. One of the reasons is that banks require monthly reimbursement while fish farmers can only pay back when they harvest and sell the fish which is after 12 to 18 months during the best of times. Interviews conducted with commission agents showed that each of them invested an average of Rs 10 million in loans for the production of fish. Profits made for this sum are equivalent to Rs 4 million over a period of 18 to 24 months. Profits are reinvested in the

production to keep the system going and therefore cannot be invested in equipments and basic infrastructure to add value on fish in order to target quality markets. Yet, if facilities were there, it is estimated that if the same investment was used to buy the fish and to add value, profit made on 62,500 kg of fish would be almost equivalent to profits made today. The main difference is that profits would be made in one transaction, ensuring increased capital flow and higher profits.

In conclusion, findings reveal that farmers and commission agents and fish buyers are trapped in a system limiting growth. The problem the sector faces is a global problem that needs to be addressed in its complexity. Focusing on improving production only would not ensure local economic and sector growth since farmers would be facing financial constraints that will in turn limit working conditions. Increasing the production without ensuring a marketing strategy and a profitable market linkage would lead to carp price fall, thus discouraging farmers from further investing in the business. Finally, considering cultural and consumer habits in Pakistan where fish consumption is one of the lowest in the world (1.5 to 1.9 kg per person per year according to FAO), a large supply of “current quality” fish on the market might not find buyers, unless a progressive marketing and educational campaign on quality products accompanying the necessary changes are carefully planned.

5. PROPOSED STRATEGY

The 3-year strategy centers on simultaneously improving productivity and marketing aspects, and operating a major shift of capital back into the sector and the supply chain to ensure economic growth.

Interventions will improve fish quality, increase fish growth and double productions, help build competitiveness on the regional market and increase fish consumption in Pakistan, and at the same time secure a healthy, structured, and professional business enabling environment. Outputs will provide farmers with a better income and forward-looking working conditions and influence. Value-added on fish product will create new employment opportunities involving women while profits made from the sale of quality products will contribute to further expand sector growth and secure its sustainability.

The strategy rests on three pillars:

- A win-win entrepreneurial farmers/commission agents-buyers model which provides an organizational framework;
- A holistic value chain traceability approach that provides a global vision for development and growth;
- Demonstration and persuasion to progressively build and scale up from pilot to district size.

5.1 A win-win entrepreneurial farmers/commission agents-buyers model

Forming an effective and profitable alliance between selected farmers and commission agents/fish buyers is intended for both developing a mutual understanding and trust, which are the bedrock of a successful and enduring supplier-buyer relationships, and to initiate substantive change.

Existing relationships between farmers and commissions agents will evolve from an informal “money lender” type of relationship toward a formal constructive partnership for the production of quality fish and to secure sustainability and availability of critical mass. The role of commission agents will be to buy the fish, to ensure proper fish handling and to manage distribution for regular supply of fish to profitable markets seeking quality.

Under the win-win entrepreneurial farmers/commission agents-buyers model, stakeholders are bound by a contract arrangement in which commission agents/fish traders agree to buy fish from the farmers at best negotiated price free of any commission if the farmer respects and scrupulously follows an agreed technical protocol that will guarantee a quality product to the end market and increased production.

The formal contract is used both as a way to improve farmer’s practices and production, and to secure quality market demand. Terms of the contract can evolve with time to meet necessary technical improvement and to satisfy consumer needs.

Farmers and commission agents/fish buyers will be organized in respective associations and will establish their own internal rules for representativeness and decision making.

The formation of this alliance or association between farmers and commission agents/fish traders will provide solid ground for commission agents to add value to the products and make valuable profits on the sale of the fish.

Accessing a more profitable and quality market will require respecting health and sanitation standards. In this respect, commission agents/fish buyers will need to invest in certain equipment, such as the ice flake machine, isotherm containers, trays and rehabilitation of working rooms with tiles, stainless steel tables, and reliable access to water.

Key to this new collaboration is the central role of a financial institution not only to facilitate but also to accompany change toward a prosperous and entrepreneurial environment. By providing banking services such as micro-credit to farmers and loans to commission agents/fish buyers, the financial institutions will create the favorable working conditions: farmers will be able to cover operational cost for a 1-year production period at a lower financial cost while commission agents/fish buyers will be able to invest in equipment without having to wait to recover the capital they lent to farmers. In order to ensure that micro-credit is used for its purpose, it is advised that it is given in kind to identified input suppliers and on a weekly basis. Moreover, reimbursement would need to be made directly from the sale of the fish to commission agents, thus leaving the farmers with net profits in hand. Such controlled mechanisms will help secure both reimbursements and productions and the results will ensure winning farmer's adhesion to the model so that in turn they will protect it.

The holistic value chain traceability approach presented below which sets the global vision for sector growth will provide further guarantees to financial institution.

The proposed strategy was presented and discussed in Karachi with seven small and medium enterprises and micro-credit banks. Tameer Bank expressed an interest in collaborating with the project. Further discussions will be needed to identify a partner willing to provide loans to commission agents.

Expected results: A major shift of capital back in the sector to ensure economic growth and an enabling business environment

Establishing a win-win entrepreneurial farmers/commission agents-buyers relationship is a strategy in itself aiming at operating a major shift of capital back into the sector. The objective is to progressively help commission agents/buyers make profit from the sale of fish and from added-value on fish so that their capital will flow more regularly and generate quicker profits that can be reinvested in the sector to ensure sustainable growth.

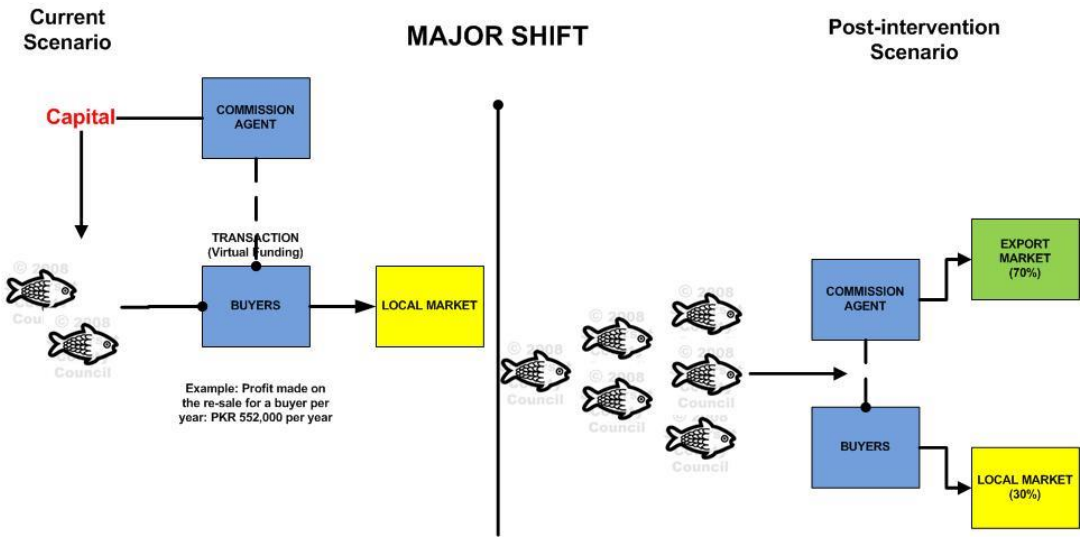

Figure 2: Creating a favorable environment for growth

Recommendations:
In order to facilitate the shift of capital, it is important NOT to give out procurement assistance to buy equipments to commission agents/buyers. They must invest part of their capital in equipments (ice flake machine, isotherm containers, trays and rehabilitating of working rooms). The trade-off can however be providing procurement assistance for a solar panel that will reduce their operational cost to run the ice flake machine and contribute to building an eco-friendly sector image.

5.2 A holistic value chain traceability approach

A value chain traceability approach is highly recommended as part of the strategy for three major reasons:

a) boosting productivity;
b) meeting consumers' needs by ensuring product traceability and an eco-label;
c) building Pakistani competitiveness in regional market.

A holistic value chain traceability approach looks at the production cycle as a whole and works at securing both ends of the value chain – access to quality seeds and feed and a profitable market linkage – to condition and secure optimum production, market delivery and sustainability (Figure 2).

The success of this approach rests on four major aspects:

1. The reliability and seriousness of the hatchery that will guarantee the origin of the seeds (including breeding practices) and work at improving seed quality and carp genetics, and at producing fingerlings of a decent sizes (from 4 to 7 inches) to ensure low mortality rate and rapid growth;
2. The availability of proper balanced and cost-effective fish feed to ensure fish with a proper diet and guaranty origin and composition of feed;

3. Regional technical assistance and training from leading regional countries in Indian and Chinese carp production;
4. A profitable partnership between the farmers/commission agent's alliance and a large supermarket that will dictate post-harvest and fish handling practices and accompany marketing strategy and development.

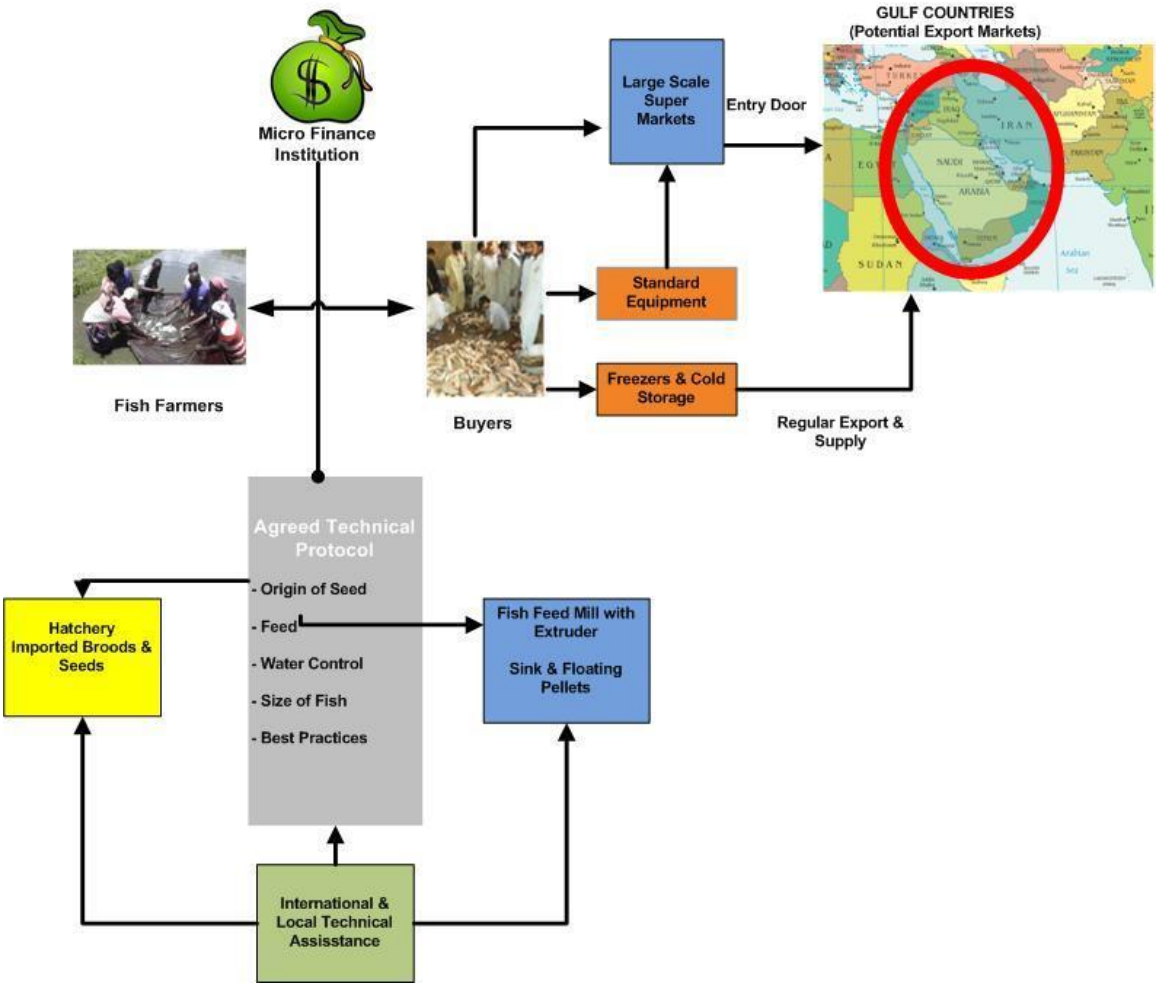

Figure 3: Holistic value Chain Traceability Approach

Expected results:

- production is doubled and growth time period is reduced by two;
- farmers income increased by a minimum of twofold per year;
- a trained and skilled labor force;
- export quality fish production;
- an increased number of jobs in the post-harvest sector involving women.

Table 1 gives a comparative analysis of estimated net profit for farmers by looking at the current situation in Sukkur and Larkana and in Muzzafargah and the situation post-intervention. Muzzafargah is a very interesting example as it is considered a success

story in Pakistan. A market linkage between Metro, a large supermarket and a few large fish farm owners has structured the production and ensured regular supply of improved fish quality to the market. Under this collaboration, farmers were taught to grow 1-2 inch fingerlings for an 8 months period prior stocking grow out ponds and to follow pond management best practices. Farmers were also taught to follow basic health practices when handling the fish. As a result, they were able to produce 40 to 50% more than farmers in Sukkur and Larkana. Their progress however is conditioned upon future availability of quality seed, proper fish feed and to the development of domestic market demand.

Project interventions will enable two cycles of production instead of one and increase the farmer's profit margin for each cycle by two to threefold. Regular production flow will enable commission agents/fish buyers to make sustained profits that can be partly reinvested in the sector.

When compared to Muzzafargah, the proposed strategy offers the advantage of boosting local economic growth by making use of existing available capital. Commission agents have not been excluded from the process. In the case of Muzzafargah, the market linkage only benefits to farmers and the large supermarket, not to the development of the sector at large.

In districts considered "at-risk", it is important to make sure that each stakeholder gets something out of the project as win-win remains the key to sustainable alliances.

Table 1: Comparative current and post-intervention scenarios (based on 1.5 kg size fish)

	Current situation in Sukkur and Larkana	Muzaffargh	Improved seed/ New feed Formula	Improved seed/ New feed Formula
	Mixed Sizes		Scenario A (1 - 2 inch)	Scenario B (4 - 5 inch)
	18-24 months cycle	18 months cycle	3+9 (or 4+8) months to production	1+8 or (2+7) months to production
Seed Cost	5 500	2000	2 000	4 500
Total Feed Cost	21 500	56 250	49 375	32 917
Other Production Costs	40 500	47 245	46 875	46 875
Financing Costs	8 000	7505	16 702	13 722
Total Cost	75 500	113 000	114 952	98 014
Revenue	108 500	174 375	180 000	180 000
Net Profit	33 000	61 375	65 048	81 986
Profitability	30%	35%	36%	46%
Sale Price per Kg	155	155	160	160
Total production (Kg)	700	1125	1125	1125

It is important to note that these figures are estimates. They highlight post-intervention results both in terms of productivity and profits. For this comparative analysis, post-intervention total production and sale price of fish have purposely been kept at a low average estimate. With practice and good use of equipment, yield per acre could reach 1300 to 1500 Kg while the price for export quality fish will need to be careful discussed and managed together with large supermarket to ensure high value and stable prices. All post-interventions figures would have to be revised based on trial experiments. While production currently takes 18-24 months, production time is expected to be reduced to 9-12 months. This is possible because of 1) availability of quality seeds which makes it possible for farmers to buy only the exact quantity required, 2) best practices at nursery and throughout production cycle (including pond management) and 3) proper feed. Two options to begin with will be made available to farmers: 1-2 inch fingerlings which they will have to rear to 5-6 inches with proper feed or 4-5 inches fingerlings which they will have to rear for one month prior to stocking grow out ponds. Tests would have to be made in Sukkur and Larkana to evaluate the exact time required to grow fingerlings and then fish. This region of Pakistan is particularly suitable for farming fish because of its long warm weather period during which fish grow.
As a result, farmers will earn a minimum of twice the amount they are getting now within one year.

Recommended interventions to promote and up-grade the value chain to ensure a traceability export quality product:

1) A model hatchery
A model hatchery will provide the basis for starting a full cycle culture practice for export quality fish production. In order to reduce mortality and growth period, the hatchery will propose different ready to use fingerling sizes varying from 1-2, 4-5 and 7 inches. Based on a preliminary diagnostic of seeds and broods available in Pakistan, the hatchery will develop short term and long term strategies to avoid problems of negative selection and inbreeding and ultimately build up its own genetically improved brood stock. For this purpose, regular regional technical assistance can be obtained from Bangladesh (and possibly China) to ensure transfers of technology on seed improvement and training to national fishery technicians, fish nutritionist and local farmers.

Hatchery development and genetic management of stocks are long term activities. Carp and pangasius need at least 3-4 generations to achieve the actual gain for ideal breed development and stock improvement. However, the first 3 years would ensure the beginning of such a programme for initiating a novel approach for carp and pangasius aquaculture farming in Pakistan.

It is expected that by the end of the 3-year strategy, the hatchery and fish feed mill ownership business model detailed below will be able to cover the cost of technical assistance to continue funding project initiated work.

Collaboration with Bangladeshi (and Chinese) experts will facilitate exchanges of experience and imports of seeds if necessary. For this purpose, it is important that experts be chosen from a well-established fisheries institution in both of these countries. A Memorandum of Understanding will be signed between these institutions and the hatchery.

Bangladesh Fisheries Research Institute (BFRI) has been identified as a valuable partner. Recent world recognized achievement in seed improvement as cultural affinities with Pakistan are solid argument to consider this option as a priority.

Close collaboration with BFRI would also facilitate experimental tests to introduce catfish, more specifically pangasius in a perspective to diversify fish species production in Pakistan. Catfish offers the advantage to grow twice as fast and has double the value of carp. However the cost of feed is higher. Future development of pangasius culture would be profitable on a large scale. It is recommended that test be conducted in collaboration with a large farm located in southern Sindh particularly suitable for fish farming.

[redacted]farms located in Chyllia has been identified as a reliable and forward-looking partner [redacted]

The introduction of best practices for pond management throughout the production cycle will necessitate equipping farmers with basic equipments such as water testing tools to assess level of fertilization and oxygen and a paddle wheel aerator to oxygenate water. In order to reduce production costs and to ensure a production respectful of environmental issues, it is recommended to equip farmers with small solar panel to run the paddle wheel aerator. Two paddle wheel aerators should be sufficient for a five acres farm, as paddle wheel aerators can be shifted from one pond to another.

2) A fish feed mill extruder processing line

Evolving from the current extensive fish farming practice that uses low input to a semi-intensive and intensive culture will require the development of allied industries such as fish feed manufacturers. The establishment of a proper fish feed mill equipped with palletting and extruder processing line that can produce floating feed is an essential aspect of the strategy. This will ensure proper diet and fish intake and to control inputs used when manufacturing the feed and will demonstrate proven increased productivity results that will in turn encourage farmers to change their perception and habits.
A business partnership with an existing poultry feed manufacturer would contribute to advancing the industry and facilitate rapid operations and productions. Technical assistance and training will be provided to run and maintain the machinery, and manufacture appropriate feed based on preliminary experimental trials for carp and pangasius. The choice of the machinery and all technical aspects would need to be discussed with regional technical assistance team and poultry feed manufacturer.

Poultry feed manufacturer, SINDH FEED has expressed an interest to invest with the project on the basis of 50-50% agreement. [redacted]

The hatchery and Fish feed Mill will be owned by an association not-for-profit, registered as a company under Section 42. The hatchery will be 100% owned by the company while the Fish feed Mill will be owned on a basis of 50% together with a private investor/poultry feed manufacturer. The company will act as an "umbrella" for the project.

This association will be composed of farmers, commission agents/fish buyers, and a financial institution who have agreed to operate with respect of Memorandum and Articles of Association and their respective investment in the sector. As mentioned in section 5.1. above, under these terms, farmers and commission agents/fish buyers sign a formal agreement whereby commission agents buy the fish at best negotiated quality market price and farmers grow fish according to agreed technical protocol. According to the technical protocol and to ensure traceability, farmers must buy seeds and feed from the hatchery and fish feed mill belonging to the company.

A board of directors composed of representatives of farmers and commission agents/fish buyers associations, a representative of end quality market buyer and representative of the financial institution will run the company. Honorary members of the board will also be invited to sit on the board and advisers and mediators. These could be for example, professionals involved in the private sector and experiences personalities from the sector.

All profits made by the company from the sale of seeds and feed will be re-invested in free technical assistance to farmers and in research and development to improve quality seeds and genetic, and disease control to ensure sustainable growth of the sector.

The hatchery

The hatchery will be managed by a professional manager/administrator in charge of the business development of the entity. This person will be the CEO of the company. Two fisheries technicians, technical assistants, field operators and a fish nutritionist will be responsible for hatchery and pond management, seed improvement and brood stock management. The fish nutritionist will work across the hatchery and fish feed mill in close collaboration with fisheries technicians and international back-up support both to ensure proper fish diet and to monitor results.

The hatchery will expand progressively following hatchery and pond management progress and to meet increasing seed demand as more and more farmers join the company.

The Fish Feed Mill

The Fish Feed Mill will be owned on a 50-50% matching basis between the company and a private investor. The collaboration would be based on the conditions that 1) the private investor/manufacturer follows the feed composition and uses quality input, 2) sales are restricted to members of the company and from year 3 to identified pro-active farms located in Muzzafargah and Thatta/Chyllia on an experimental base and development incentive as decided by FIRMS-USAID funded project and 3) follow quality control and scientific monitoring. The Fish feed Mill will be operated by the

investor/manufacturer and overseen by the CEO of the company in close collaboration with fisheries technicians and fish nutritionist.

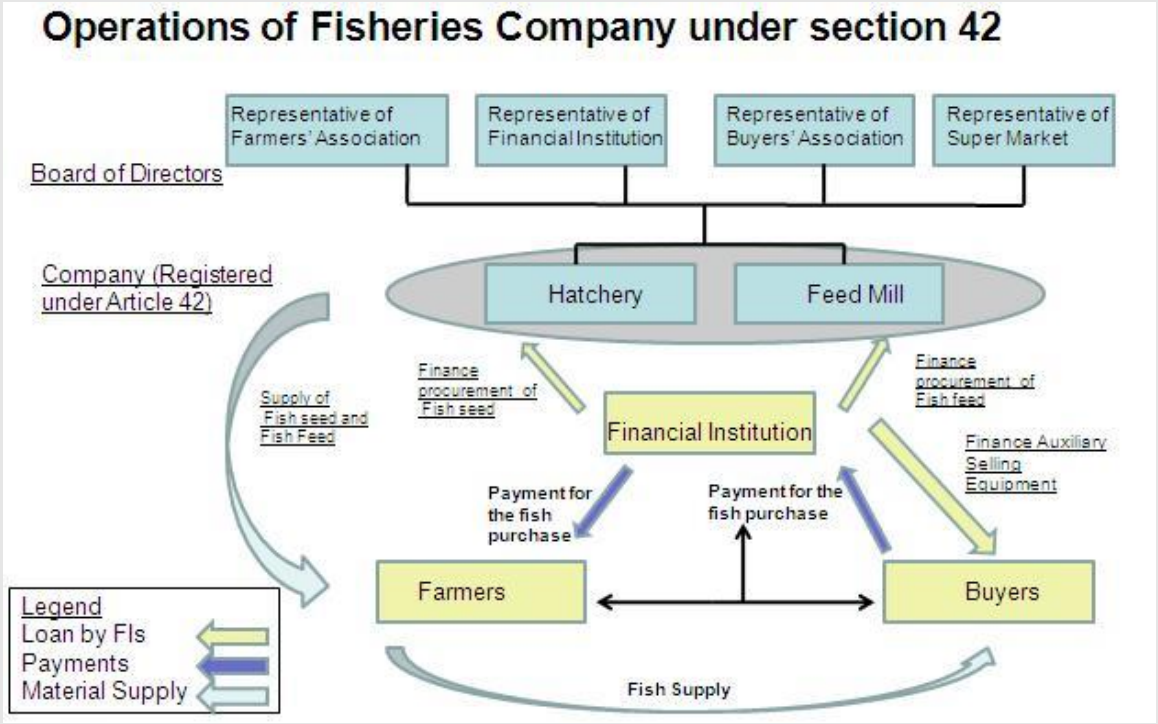

Figure 4: Proposed Hatchery and Fish Feed Mill Ownership Model

3) Partnership with selected large supermarket and marketing strategy

The choice of partner for the project is crucial to the strategy and must be done on certain criteria as follows:

- high quality requirement;
- growing national demand to secure progressive production supply;
- established connections in Gulf countries to facilitate future distribution;
- willingness and understanding to engage in community relations.

The objective of this partnership is not to establish a basic market linkage in order to sell production. The main objective is to build a profitable lasting and constructive relationship that will accompany the process of up-grading the value chain and building competitiveness in the region for eco-friendly export quality products. Special care and attention need to be given in fostering dialogue to ensure mutual understanding. This will involve farm and local market visits from the large supermarket and supermarket visits form the farmers and commission agents/buyers. Quality requirements and consumer needs will be dictated by the large supermarket to commission agents/fish buyers. In this respect, commission agents/fish buyers will need to invest in proper working rooms, ice flake machines, isotherm containers and plastic trays.

Contact has been established with Hyperstar, a large supermarket established in the Gulf region and in Pakistan, which is currently planning to open major stores in the

country. Their contribution with respect to quality control and future certification of product, as part of their collaboration with farmers and commission agents, would ensure not only the quality of the product, but rapid consumer's trust that will help build loyalty to the products.

Hyperstar has shown an interest in the project. Partnership agreement between Hyperstar and farmers/commission agents alliance would have to be settled at the beginning of the project.

4) Marketing and sales

Most profitable market for carp is the domestic market. Firstly, Pakistan has a population of nearly 180 million people. Secondly, carp sells at a higher price in Pakistan than in the region mainly because consumers prefer fresh fish. One way to differentiate productions from Pakistan is traceability of product, eco-friendly farming environment and future certification.

With a carefully planned marketing strategy promoting traceability export quality product in large supermarkets and high end market hotels and restaurants, Sukkur and Larkana produced fish will have plenty of opportunities. Large supermarkets attract thousands of consumers each day and contribute to changing consumer habits. Special care will need to be provided to meet quality, packaging and food safety standards of large supermarket. Collaboration with Hyperstar can also be very valuable for future distribution to Gulf markets. However, trial export shipments to Gulf by the end of the project should be seen as part of the strategy to reinforce and develop carp market sales in Pakistan and to create a demand both from domestic and international market for quality products that will in turn encourage further investment and development in the sector.

Thus, a marketing strategy is essential right from the start to differentiate Larkana and Sukkur productions from other current carp productions in the country. A preliminary Persian Gulf market linkage tour will need to be conducted year 2. Sukkur and Larkana commission agents should invite potential identified buyers from that region to visit farms in Pakistan. Considering an increasing market demand from Afghanistan, a market survey will be conducted in year 2 to explore opportunities.

The following activities will need to be conducted at the beginning of the project with the help of professionals:

- Branding strategy for Pakistan farm fish
- Brand Logo
- Packaging Material
- Design of Pavillion for Pakistan Fish Cluster
- Participation in international fish fair (TBD)

In order to increase fish consumption in Pakistan, an awareness campaign would need to be launched with farmers participating in targeted marketing sale operations at fish bazaars in Karachi, Lahore, Islamabad and Quetta.

5) Benchmark tours

Five benchmark tours have been identified to build awareness and motivate future perspectives. It is highly recommended that selected farmers and commission agents, representative of the financial institutions, representatives of fish feed mill take part in five tours to build and strengthen partnerships and to develop a mutual understanding. With respect to market quality:

- Seafood fair organized in Hong Kong (Sept. 2010)
- Singapore fish market

With respect to production and opportunities

- Visit to Bangladesh organized by Bangladeshi technical team
- Visit to China organized by Chinese technical team
- Visit to Vietnam at major pangasius exporting farms and processing plants.

6) Training

Specific training will need to be carried out throughout the first year while back-up and up-date will be provided on a regular basis by international and local technical team. In order to develop a mutual understanding, it is recommended that farmers and commission agents/buyers be provided training about each other's basic trade.

The following training needs with respect to farmers and commission agents/buyers are as follow:

<u>Farmers</u>

Training on entrepreneurial skills & accounting
Training on fish farming best practices
Training on fish handling
Training on integrated supply management systems training
Farm equipment management training
Pond & water management training
Production management training
Fish disease management training

<u>Commission agents/fish buyers</u>
Training on entrepreneurial skills & accounting
Training on fish farming best practices
Training on fish handling
Training on integrated supply management systems training
Training on fish quality standards
Training on fish processing
Training on marketing & market linkages
Training on computer skills

5.3 From a pilot to district size project: Planned interventions over 3 years

The third pillar of the strategy is focused on demonstration and persuasion to progressively build and scale up from pilot to district size (Figure 4). Considering the context, local practices and farmer's perceptions, it is recommended to start working with five farmers (owning five acres each) and one or two commission agents/buyers.

Selection criteria will be based on principal's motivation and adhesion to the vision and proposed development model. Farmers and commission agents/buyers will be organized in respective associations as described in Section 5.1. The choice of participants is very important as they will not only be an example, they will play an active role in the scaling up by taking part in selecting newcomers at the end of year 1 and following years. Farmers from the area will be invited to witness results. It is expected that 45 farmers will join at the end of year 1, followed by 100 farmers in year 2 and another 150 farmers by year 3 to reach a total number of 300 farmers with farms of varying sizes covering an area equivalent to a total of 2500 acres. As productions develop, it is expected that new commission agents/buyers will join in the association, thus leading to further investment in the sector. Based on an average production of 1300 kg/acre per year by year 3, yearly production by the end of the project is expected to reach 3 250 tons of eco-friendly traceability export quality fish. Productions are intended in priority for Pakistani market. By the end of year 3, attempt to export first carp trial shipment will be made to test Gulf markets.

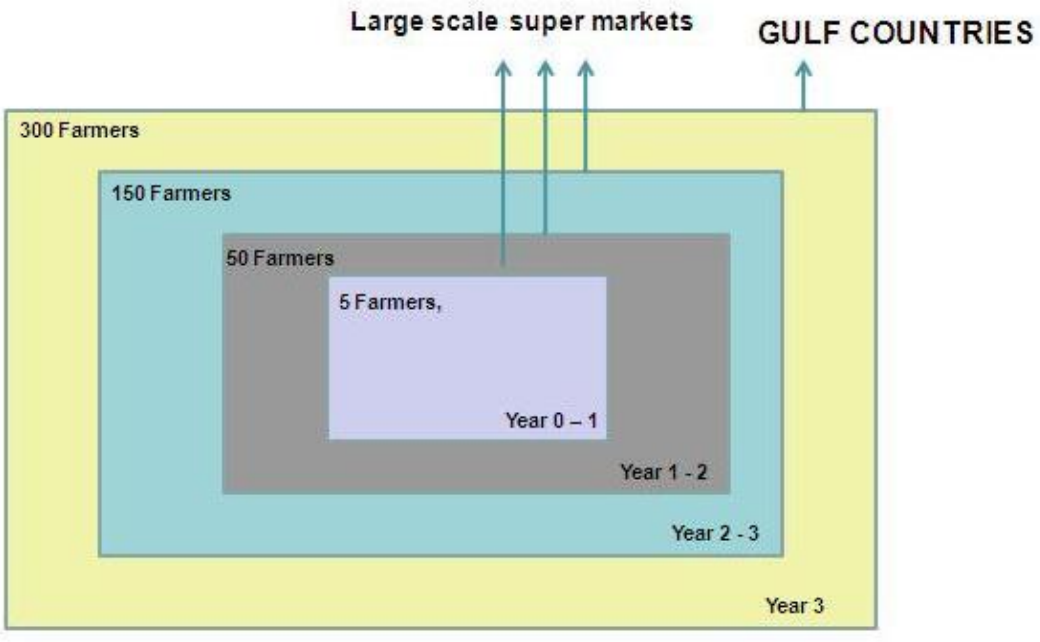

Figure 5: From Pilot to District Size Level

Table 2 below presents a summary of interventions over 3 years.

Table 2: Summary of interventions over 3 years			
Interventions	**Year 1**	**Year 2**	**Year 3**
Overall Sindh fisheries project design and functioning	Consultation with stakeholders in Sukkur and Larkana; selection of 5 farmers and 2 commission agents; signature of partnership agreement; creation of company under section 42. MoU with 5 selected farmers and 2 commission agents. Demonstration of results to stakeholders in Sukkur and Larkana. MoU with large farm owner for catfish trial experiment	First company general assembly; Selection of 45 farmers and 5 commission agents; signature of partnership agreement; MoU with 45 selected farmers and 5 commission agents. Demonstration of results to stakeholders in Sukkur and Larkana. Selection of 100 farmers and 7 commission agents; signature of partnership agreement; MoU with 100 selected farmers and 7 commission agents.	Second company general assembly; Demonstration of results to stakeholders in Sukkur and Larkana. Selection of 150 farmers and 7 commission agents; signature of partnership agreement; MoU with 150 selected farmers and 7 commission agents. MoU with farm owners in Muzzafargah
Fish Hatchery Sindh	Identification of suitable land for lease; Feasibility study, hatchery design, Assessment of existing carp brood and collection of materials (if found suitable) to stock and rear at hatchery; Import of seeds if necessary through Pakistan and Bangladesh MoU; brood stock development and seed production;	Brood stock development and seed production; Procurement for hatchery construction material; Development of plans and strategies for breeding program and genetic improvement including dissemination of improved improved breeds/seeds; setting brood stock replacement and	Brood stock development and seed production; Procurement for hatchery construction material; Development of plans and strategies for breeding program and genetic improvement including dissemination of improved improved breeds/seeds; setting brood stock replacement and

Table 2: Summary of interventions over 3 years			
Interventions	**Year 1**	**Year 2**	**Year 3**
	Procurement for hatchery construction material; Development of plans and strategies for breeding program and genetic improvement including dissemination of improved breeds/seeds; setting brood stock replacement and other genetic management	other genetic management; disease control and management	other genetic management; disease control and management
Fish Feed Mill Project	Signature of Business partnership with company registered under section 42 by private investor; Investment in fish feed mill extruder equipment; Technical assistance and training for feed formulation and brood stock feeding plan development	Business management assistance; Technical assistance for feed formulation and brood stock feeding plan development	Business management assistance; Technical assistance for feed formulation and brood stock feeding plan development
Fish Farm Development in Sindh	Capacity-building for 5 farmers; Procurement for equipments (paddle wheel aerators, water testing kit, solar panel	Capacity-building for 145 farmers; Procurement for equipments (paddle wheel aerators, water testing kit, solar panel	Capacity-building for 150 farmers; Procurement for equipments (paddle wheel aerators, water testing kit, solar panel

Table 2: Summary of interventions over 3 years			
Interventions	**Year 1**	**Year 2**	**Year 3**
Development of Fish Commission Agents	Capacity-building for 2 commission agents; Procurement for solar panel	Capacity building for 12 commission agents; Procurement for solar panel	Capacity building for 7 commission agents; Procurement for solar panel
Microfinance and loan program	Identification of financial institution (s); MoU between financial institution and selected farmers and commission agents;	MoU between financial institution and selected farmers and commission agents	MoU between financial institution and selected farmers and commission agents
Market Linkages	Match making with local and international large supermarkets; Branding; Marketing strategy.	Supply management assistance; Quality control in collaboration with large supermarket; Prospective market tour in Gulf; Market study in Afghanistan	Supply management assistance; Quality control in collaboration with large supermarket; First trial shipment to Gulf market.
International best practice tours	Market quality: Hong Kong Seafood fair and Singapore fish market Production: Bangladesh, China and Vietnam 10 persons involved	Visit of farmers from Bangladesh to Sukkur and Larkana farms	Visit from Gulf market to Sukkur and Larkana farms
Awareness campaign targeting fish consumers	Fish bazaar and national campaign	Fish bazaar and national campaign	Fish bazaar and national campaign

Expected results are progressive and sustainable change as well as an extended positive impact on fish handling at large. Sukkur is a very important fish market, gathering fish farming and inland capture productions from all neighboring districts. Investments made in equipments to ensure project quality products, will also be used to add value on other productions, thus improving supply from this region of Pakistan. This will in turn contribute to make a name for Sukkur and Larkana and to encourage fish consumption in the country.

5.4 From district to national fish farming development

While working at district level, the strategy is also designed to have an extended impact on fish farming that will secure operations in Sukkur and Larkana while at the same time providing an industrial outlook for the sector.

Two recommendations to strategically use the project's investment for broader impact:

1) Based on results in Sukkur and Larkana, and the end of year 2, fish feed mill can sell fish feed to pro-active farmers in Muzzafargah to increase their productivity. Mutual visits would need to be organized in order to facilitate collaboration and to introduce the Sukkur-Larkana model in Punjab. Profits made from the sale of fish feed can contribute to the company's financial autonomy by the end of the project, therefore ensuring provision of technical assistance to farmers and continuation of work on seed improvement;

2) Experimental trial for pangasius (catfish) will be conducted by the Bangladesh team, operating from the hatchery, in collaboration with fish feed mill and large farm owner. If tests are successful, it is expected that large farm owner will invest in the production of catfish on a large scale, the first of its kind in Pakistan.

The project will not only empower principals at local level. It will create an enabling business environment for future development of the sector and its allied industries.

6. MONITORING AND INFORMATION MANAGEMENT

The proposed strategy requires a control and monitoring of all the sequence of steps involved in the production process starting at hatchery level right down to post-harvest practices.

The project will need to establish a dedicated M&E team as part of its coordination unit. Under the supervision of the Project Manager, the M&E team will be responsible for designing and implementing an integrated M&E system that will provide the basis for determining the impact of different project interventions and the efficiency of the approach as well as the basis for communication with project stakeholders. An International M&E expert will provide regular oversight and technical assistance to the M&E team.

Communication is crucial for building confidence and improving practices. This is valid for both farmers and commission agents/buyers. Information management is also important with respect to marketing purposes and future development of an eco-friendly label and certification. An experienced communication expert will work closely with the Project Manager on these issues and report on a regular basis to FIRMS' Project Management Unit.

7. RECOMMENDATIONS

The proposed strategy goes beyond establishing a market linkage between fish farmers and the market. It is guided by two main objectives: The first one is to empower local communities in Sukkur and Larkana to drive their own development and progress through critical mass eco-friendly export quality fish production activity. The second is to ensure that the project's investment will contribute to improve the fisheries sector, at large, by building confidence in the emerging industry. The impact and success of the strategy depends on the following factors.

1) Marketing strategy to accompany production increase and prevent price drop
Market intelligence will play a key impact in ensuring the implementation of a strategy that will benefit stakeholders. Supply should be progressive in order to meet increased consumer demand while at the same time ensuring price stability. Price drop could greatly affect the farmer's motivation and future investment in the sector. Special attention will need to be given to building an alliance between farmers, commission agents/buyers, financial institutions and large supermarketS to ensure sustainability. Market linkages with export opportunities should be seen as a way to attract and further develop domestic demand.

2) Success story: Guide progress and collaboration with Muzzafargah and Chyllia
Project intervention to make proper balanced and cost-effective fish feed available to pro-active farms in Muzzafargah could increase USAID's visibility. However, it should be managed and monitored carefully in relation with a marketing strategy to protect Sukkur and Larkana's progress and share of the market. Strategic communication would need to be elaborated to safeguard established market linkages with [redacted]
Pangasius trial experiment will encourage selected large farmer's investment in the sector. This investment will contribute to providing the first industrial outlook to the sector. Project will need to facilitate market linkage in order to ensure smooth outcome for the production of catfish.

3) Secure future development for Company registered under Section 42
Considering the context in Pakistan, registering the company under Section 42 appears to be the most feasible option during the time of the project to demonstrate the viability of the sector and its prospects. However, it will need to be marketed in the near future to private investor to protect the initiative and to give a true boost to the industry.
This assignment could be completed by a feasibility study.

4) Coordination of activities at district
Coordination of Firms's project activities in Sukkur and Larkana area would add significant value and increase development opportunities in the sector. It would also contribute to peace building in this region of Pakistan which would be profitable for reviving tourism in the area, thus strengthening a locally produced fish label.

8. ALTERNATIVE SHORT-TERM INTERNVENTIONS

Two alternative short-term interventions would contribute to improve the sector:

1) **Facilitating farmers' access to micro-credit**

A micro credit could help farmer in two ways; firstly, it would ensure the availability of the total amount of money he needs to cover operational cost; and secondly it would reduce its financial cost. USAID could facilitate access to a micro-credit institution willing to support farmers.

2) **Improving seed quality by investing in genetic stock improvement research of carp species**

Genetic degradation of stocks is a major issue leading to poor quality seeds. A collaboration with the Fishery Development Board (FDB), a public-private enterprise, interested to work on this issue could help improve access to quality seeds and ensure the basis for future fish farming development. Facilitating technical back-up from Bangladesh Fishery Research Institute (BFRI) who has been conducted genetic stock improvement research since 1994 and has recently been awarded for their outstanding achievement is strongly recommended.

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